

PERFORMANCE AND EVALUATION REPORT

Reporting Period: from Dec 1994 to April 1996

Final Report - Grant #P.O. S-30915-F

1. **PRINCIPAL INVESTIGATOR:** Richard D. Robinson
2. **INSTITUTION:** Computer Sciences Corporation
3. **PROJECT TITLE:** Coordinated HST-EUVE Observations of YZ CMi
4. **SUMMARY OF PROJECT ACTIVITIES:**

1. **Brief description of the primary objectives and scope of the project:**

The observations were taken as part of a coordinated observing campaign which was designed to study flares on the dMe star YZ CMi. The campaign also included rapid spectral time sequences in the optical (using the 3.9m Anglo-Australian Telescope) and UV (using the GHRS aboard the Hubble Space Telescope and the IUE satellite) and radio observations taken with the Australia Telescope and VLA. The goal was to investigate the physical characteristics of the flares in different temperature regimes with a time resolution which is high enough to investigate the dynamics of the events.

2. **Brief description of the findings:**

The EUVE observations covered 52 orbits obtained on 21-24 Dec 1994. The Lex/B lightcurve is dominated by a large flare event which began at $\sim 12:30$ UT on 22 Dec and lasted for nearly 1.5 days. This flare had a maximum flux which was about three times the quiescent level and showed a peculiar double peak, with the two maxima separated by about 4 hours. Normally, such a structure would simply be interpreted as two superimposed flares, however, coordinated optical and radio data show that the first peak in the EUV had no associated optical or radio enhancements, while the second peak was coincident with a classical, impulsive enhancement at both optical and radio wavelengths. We are therefore interpreting the first EUVE peak as a flare precursor associated with an expanding magnetic loop.

Spectra were obtained for both flare peaks as well as during the decay phase of the flare and during quiescence. These spectra show that the flare is dominated by plasma at a temperature of $\sim 10^7$ K which has $\log(\text{VEM})$ of about 50.5. Using this in conjunction with an analysis of the Lex/B light curve (which has been described by Hawley et al, 1995, ApJ, 435, 464), we were able to derive some of the physical properties of the EUV source region. The analysis shows that the source is a magnetic flux tube having a length of 2×10^{10} cm, an average electron density of $3.5 \times 10^9 \text{ cm}^{-3}$, and a total volume of $2.4 \times 10^{31} \text{ cm}^3$.

All of the HST observations were obtained on 21 Dec. These data consist of rapid spectroscopic time sequences covering the wavelength range from 1150-1440 Å. During more than 22 hours of observing, approximately 9 of which were on the source, we detected a total of 10 well defined flare events. Some of these were associated with optical and radio bursts, but none were accompanied by a significant increase in the EUV flux. The lack of high temperature plasma in these flares is supported by an analysis of the GHRS data, which shows that the lines having the greatest flux increase during the flare were formed at temperatures of $\sim 7 \times 10^4$ K. The Fe XXI line at 1354 Å had no significant increase during any of the flare events. We have therefore concluded that there are two basic types of stellar flares. The first is a compact event which

primarily shows up at optical and UV wavelengths and contains plasma with temperatures less than 10^5 K. The other type is much larger and longer lasting and is associated with the heating of plasma to 10^7 K or more.

3. Name and date (or anticipated date) of the publication of the results:

The EUVE observations are being presented in the paper "Multiwavelength Observations of a Transient Event on the dMe Flare Star YZ Canis Minoris", which is currently in preparation and will be submitted to the Astrophysical Journal. This paper describes the large flare event on 22 Dec 1994. The EUVE data will also be discussed in a second paper describing the UV observations obtained with the GHRS. Funding for these papers will be provided by a follow-on grant.